

Issued February 7, 1910

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF ALLEN COUNTY,
INDIANA.

BY

GROVE B. JONES AND CORNELIUS VAN DUYNE.

[Advance Sheets—Field Operations of the Bureau of Soils, 1908.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1909.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS,

Washington, D. C., May 25, 1909.

SIR: The work of the soil survey in Indiana during the season of 1908 included the Allen County project, which lies in an important agricultural district in the northeastern part of the State. Requests for this work bore the indorsement of Hon. C. C. Gilhams, within whose district the county lies.

I have the honor to transmit herewith the report and map covering this work and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils for 1908, as authorized by law.

Very respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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MAP.

Soil map, Allen County sheet, Indiana.

SOIL SURVEY OF ALLEN COUNTY, INDIANA.

By GROVE B. JONES and CORNELIUS VAN DUYNÉ.

DESCRIPTION OF THE AREA.

Allen County is located in the northeastern part of Indiana, and is bounded on the north by Dekalb and Noble counties; on the east by the State of Ohio; on the south by Wells and Adams counties; and on the west by Whitney and Huntington counties. The county is included within meridians $84^{\circ} 50'$ and $85^{\circ} 20' 25''$ west from Greenwich and parallels $40^{\circ} 50' 30''$ and $40^{\circ} 18'$ north latitude. It is the largest county in the State, and embraces an area of 667 square miles, or 426,880 acres.

The surface features of the county are those characteristic of a glaciated region, varying from low, level, or depressed areas—the sites of ancient lakes—to rolling and hilly, the latter being the usual surface features of moraines. The morainic belt extends in a north-

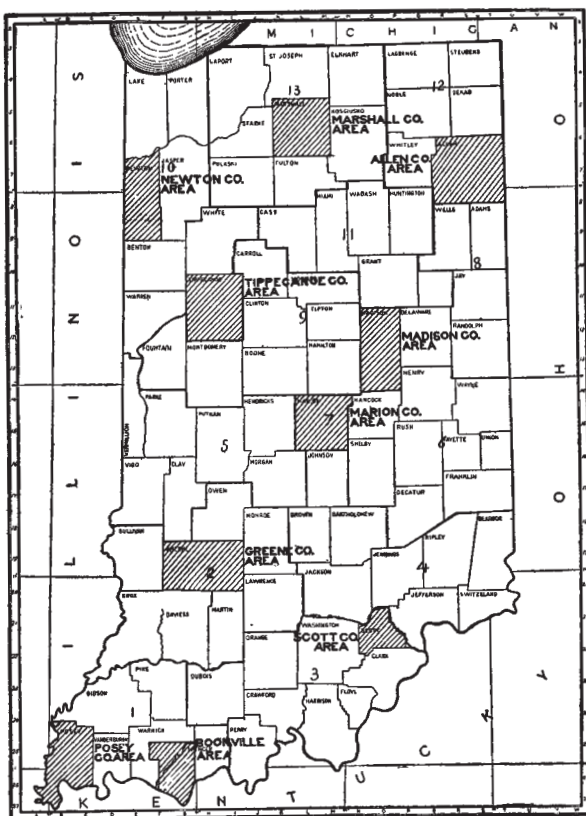


FIG. 1.—Sketch map showing location of the Allen County area, Indiana.

easterly-southwesterly direction across the county. It passes through Fort Wayne, where it is intersected by the St. Joseph and St. Marys rivers, which at this point unite to form the Maumee River. From Fort Wayne a lobe of this moraine extends southeast to the county

line. The extreme northwest corner of the county is also crossed by another morainic strip.

These morainic belts present a varied topography and give to the county is most rugged scenery. Though their general elevation is much above the surrounding country and their surface for the most part is rolling to hilly, there occur many small, level to gently undulating areas. Between the morainic hills and ridges numerous swamps, saucerlike depressions, and small lakes form a salient feature of the landscape everywhere. In the northern part of the county the hills and kamelike eminences occur particularly well developed, especially in Perry and Cedar Creek townships. The highest point in the county is located upon "Dutch Ridge," in Perry Township. This ridge is a broken, gullied strip of country, with an average height of about 50 feet above the surrounding lowlands. The sides of the ridge are badly dissected and eroded by deeply cut, steep-sided, irregular valleys, varying in width from one-eighth to one-fourth mile. Some of the valleys in the morainic country have the appearance of having carried much larger volumes of water in former times and of having later become partially filled with glacial débris. These valleys vary in width from one-eighth to one-fourth mile.

Generally speaking, the southern half of the county consists of intermorainic stretches having a gently undulating to fairly level topography. The exceptions are found in the southwest corner and along the east side of the St. Marys River, where the moraines give rise to gently rolling to hilly country.

The Maumee Lake Bottom, which embraces over 100 square miles of country in the eastern part of the county, is the largest level area. The surface features are level to gently undulating, with an occasional knoll or ridge. This tract was known as the Black Swamp, but has been reclaimed by artificial drainage.

Another level semiswampy area is found extending southwest from Fort Wayne to the western boundary of the county. This formation represents an abandoned channel which at one time conveyed the waters of Lake Maumee into the Wabash River. It is locally known as Little River Prairie.

The St. Joseph and St. Marys rivers rise in Ohio and flow through the eastern portion of Allen County to Fort Wayne. The St. Joseph flows in a general southwesterly direction, the St. Marys in a northwesterly direction, until they unite at Fort Wayne, forming the Maumee River. The eastern and central parts of the county are therefore drained by these three rivers and their tributaries.

The western part of the county is drained by Eel River, Aboite Creek, Little Prairie Creek, and the tributaries of these streams. This drainage is in a southwest direction to the Wabash River. The

county thus forms a watershed, part of whose waters discharge through the Maumee, the Great Lakes, and the St. Lawrence into the Atlantic, and the rest through the Wabash, Ohio, and Mississippi into the Gulf of Mexico.

Fort Wayne, the only city of the county, has an estimated population of 61,195. It is situated nearly in the geographical center of the county and is sometimes called the "Summit City," because it is at about this point that the east and west railway lines cross the divide between the waters which flow into the Mississippi and those which flow into Lake Erie. Fort Wayne is the county seat and is a progressive and prosperous city. It covers an area of 9 square miles and has a number of manufacturing plants.

There are a number of small towns and villages in the county. In the northern half are Dunfee, Arcola, Hometown, Ari, Leo, Cedarville, Grabill, Maysville, Harlan, and Woodburn, named in order from west to east. In the southern half and named in the same direction are Zanesville, on the southern margin, Ninemile, Yoder, Poe, New Haven, Hoagland, Maples, Monroeville, Townley, Baldwin, Dixon, and Edgerton.

General Anthony Wayne, on September 18, 1794, selected the present site of the city of Fort Wayne, at the junction of the St. Marys and St. Joseph rivers. This early white settlement was known as Fort Deposit, and furnished protection to the pioneers. Much interesting history is linked about this spot. It was called by the Indians Ke-ki-on-ga, meaning "Central City."

Under the treaty of St. Marys, 1818, lands ceded by the Indians came into possession of the United States. In 1822 Fort Wayne was laid out, and in 1823 the county of Allen was organized out of Randolph and Delaware counties.

The first settlers came in by way of the St. Marys River, from Ohio, New York, and other eastern States. They selected the timber lands along the St. Joseph and St. Marys rivers for their first settlements. The tide of immigration, however, did not begin until the decade of 1840-1850.

The county roads as a rule are in good condition. The principal roads leading into Fort Wayne are macadamized or graveled, and in the eastern and southeastern parts of the county there are many miles of permanent macadam roads. Much of the material used for road construction is a durable blue limestone, but upon about half of the roads of the county the gravel deposits, which are so common in the morainic sections, have been utilized. This material is often too fine for good results, and in all cases is less durable than the limestone. Where the Clyde clay and other heavy soils are crossed by roads not graveled they become, in wet seasons, almost impassable from deep, stiff mud.

Allen County is well supplied with railway lines. With the exception of the extreme northeastern township, Scipio, every township is traversed by one or two lines of railway, and shipping points are easily reached from all parts. The following railroads enter Fort Wayne: The Pennsylvania (main line), the Grand Rapids and Indiana, the Wabash (two lines), the Lake Erie and Western, the Lake Shore and Michigan Southern, the New York, Chicago and St. Louis, and the Cincinnati, Hamilton and Dayton. The Vandalia Railroad crosses the northwest corner of the county and furnishes an outlet for that section. In addition to the steam roads the following electric lines center at Fort Wayne: The Fort Wayne and Wabash Valley Traction Company's lines run southwest from the city along the northern edge of the "prairie" to Huntington, Indianapolis, and Lafayette. Another line runs south to Bluffton. The Ohio Electric Railway Company's lines pass east through New Haven and Monroeville to Van Wert and Lima, Ohio. The Fort Wayne and Springfield Railway runs southeast to Decatur, and the Toledo and Chicago Interurban Railway runs north through Huntertown to Waterloo. A proposed electric line running northwest from Fort Wayne will, when completed, connect it with South Bend, Ind.

Fort Wayne is the market for all of the products of the county, and considerable produce is shipped in from outside districts.

CLIMATE.

The climate of Allen County is healthful and well suited to carrying on general farming. No official weather records are available for the county; those which appear in the accompanying table were taken from the records of the Weather Bureau station at Angola, two counties to the northward. It is believed, however, that the data given represent approximately the conditions which prevail over Allen County.

The winters are rather long and cold, and are usually accompanied by considerable snow. The mean temperature for December, January, and February, covering a period of eighteen years, is about 26° F., while that for the three following months for the same period is about 48° F. The mean temperature for the months of June, July, and August, covering a period of eighteen years, is about 72° F., while that for the three following months for the same period is about 51° F. The mean annual temperature is about 49° F. The temperature seldom reaches 100°, and zero weather seldom lasts for more than one or two days at a time.

The mean annual precipitation for a period of eighteen years is about 39 inches. The mean snowfall for December, January, and February covering this same period is about 29 inches. During

these same months, however, a considerable precipitation—about $2\frac{1}{2}$ inches monthly—occurs in the form of rain. For March, April, and May the mean rainfall is about 10 inches, while the snowfall is also about 10 inches. During the summer months of June, July, and August the average rainfall is about $3\frac{1}{2}$ inches per month, while that for the following three months is about the same. In general, the rainfall is quite evenly distributed throughout the growing season. Crops seldom suffer from extreme drought or from excessive moisture.

The length of the growing season is about five and one-half months, the average dates of the last killing frost in the spring and the first in the fall for a period of fifteen years being April 27 and October 14, respectively. During this same period the very latest date of a killing frost in the spring was May 21, and the earliest in the fall was September 21. The climatic conditions of the county are representative of those over a large portion of the northeastern United States.

Normal monthly, seasonal, and annual temperature and precipitation at Angola.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute max-imum.	Absolute min-imum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	29	65	-13	2.6	2.0	1.5	8.7
January	24	64	-20	2.4	1.8	2.4	10.8
February	24	62	-25	2.8	2.2	2.0	9.7
Winter	26			7.8	6.0	5.9	29.2
March	34	76	-10	3.0	2.7	3.1	7.8
April	48	90	15	2.8	2.1	5.9	2.7
May	61	100	26	4.0	6.6	4.4	0.2
Spring	48			9.8	10.4	13.4	10.7
June	70	104	38	3.9	1.8	3.6	0.0
July	74	104	45	4.0	1.1	12.8	0.0
August	71	101	44	3.2	0.9	7.6	0.0
Summer	72			11.1	3.8	24.0	0.0
September	64	100	28	3.5	5.2	5.9	0.0
October	51	90	18	2.9	3.0	0.8	0.1
November	38	76	7	3.6	2.7	2.1	5.1
Fall	51			10.0	10.9	8.8	5.2
Year	49	104	-25	38.7	31.1	52.1	45.1

AGRICULTURE.

The development of agriculture in the early days was necessarily slow, for the country was heavily forested with oak, hickory, elm, maple, beech, and other hardwoods. Corn was the chief crop planted in the partially broken new ground. This crop was usually followed

by wheat, while another area was cleared for corn the following year. On account of the absence of ready markets the most of the grain produced was consumed at home. Occasionally ox teams hauled small loads of grain to Chicago or Cincinnati and returned with other provisions. On account of the distance and the poor condition of the roads such trips usually required several weeks.

Upon the completion of the Erie-Wabash Canal in 1843, which furnished direct communication with the Ohio River, the development of agriculture became more rapid. Large areas were cleared, better farming implements were used, and higher prices were paid for the products.

After immigration became active in the forties and fifties, the development was steady. About twenty years after the completion of the canal—that is, in 1863—the Wabash Railroad was constructed and other lines soon followed, forcing the abandonment of the canal in 1881. About this time large areas of swamp land lying south of the canal were cleared, drained, and put in cultivation, and to-day only a small percentage remains unreclaimed. These drained swamp lands are the strongest corn soils in the county, command the highest price, and are an important factor in the county's wealth.

The general character of agriculture has not greatly changed since the beginning. Corn and wheat constituted the first crops, but the yield of wheat has gradually decreased because of continuous cropping, and more attention has been given to oats and hay. During the last twenty years the acreage devoted to corn and oats has greatly increased, owing to the draining of the swamp lands. According to the census of 1900 the number of acres in corn was 70,840, in oats 50,715, and in wheat 3,765. This year, 1908, it is believed the wheat acreage is not over 2,000 acres, though this small showing is due partially to the very dry fall, which prevented seeding. The average yield per acre of hay for the county is about $1\frac{1}{2}$ tons. The first crop of clover is cut for hay and the second generally harvested for the seed. By this method little or no humus is added to the soil and the grass lands of the county are generally deficient in organic matter. Alfalfa can be successfully grown on the upland soils and should be more extensively planted. It will prove a valuable feed, a splendid soil renovator, and of importance in the system of rotation. Buckwheat, rye, rape, and sugar beets are grown to a limited extent. The sugar beets are produced upon the Clyde clay in the eastern part of the county, the yields ranging from fair to good. The beets are shipped to Fremont, Ohio, where is located the nearest sugar factory.

The soil and climatic conditions are well suited to sugar beets, and there would seem to be no reason why the acreage of this crop should not be greatly increased. Many of the beets now produced are grown under contract, the price paid being \$5 a ton. The cost of seed per

acre is \$2.50, for the hire of the company's tools 55 cents, and weeding and thinning \$18 per acre. The yield this year ranged from 8 to 10 tons per acre. Comparatively little commercial fertilizer is used.

Stock raising has never been of great importance and at present is confined chiefly to the production of pork. Dairying has never been extensively carried on and provides only for the local demand.

With the growth of Fort Wayne into a large manufacturing city and the resulting increase in demands for fruit and vegetables, more attention has been given to these special crops. The city furnishes a splendid market for such products, all of which do well on the sandy soils just east and west of town. Apple and peach orchards planted upon the Dunkirk sandy loam and given proper care will doubtless prove remunerative. Potatoes grow well upon the lighter soils and upon the lighter phases of the Muck and Peat areas. The supply of vegetables and fruit is even yet inadequate, and many carloads are shipped in annually.

The importance of crop rotation is recognized and quite generally practiced upon the Miami clay loam. The common practice consists of plowing sod land for corn, following this with oats, and then with wheat. If wheat is included in the rotation, timothy is usually sowed in the fall and clover in the spring; otherwise both are sowed in the spring with the oats. The land is allowed to remain in grass for two or three years, the period depending usually on the ability of the clover to withstand the heaving of the soil and on the relative prices of hay and corn. On the Miami black clay loam wheat is usually omitted from the rotation and corn is planted for two or more years. The Clyde clay is planted to corn for several successive seasons, followed by oats, seeded, and allowed to remain in clover only one year.

The matter of drainage is an important problem for the farmer of Allen County, and especially is this true in the eastern and north-western parts of the county. Most of the farms of the upland are equipped with effective systems of tile drains. In the large level tracts of land the main open ditches become partially filled with sediment and plant growth and require frequent cleaning. Ditching machines for constructing the small lateral ditches are in common use. Tile is manufactured in several places in the county and can be secured at reasonable prices.

Eel River ditch, completed in 1887, is 11 miles long and drains over 3,000 acres of land. Little River ditch, completed in 1889, with all its branches, is 40 miles in length and furnishes an outlet for the water which falls upon 200,000 acres.

In 1900 the value of farm lands and improvements of Allen County, exclusive of buildings, was \$14,565,350, and the value of farm buildings amounted to \$4,707,320. The farms contain a total area of 397,235 acres and have an average extent of 90 acres. The

value of farm land ranges from \$50 to \$150 an acre. The corn and truck soils command the highest price. Drained Muck sells for about \$80 an acre, and much of this soil could be improved by more complete drainage systems.

About 60 per cent of the farms are operated by the owners. Where tenanted, share rent is the common plan, although a money rental is coming into more general use. The usual rent on the share basis is two-fifths of the products, the renter furnishing everything. When the owner furnishes the seed, etc., he gets one-half of the products. Money rents range from \$2 to \$5 an acre, depending upon the kind and condition of the soil and the character of the improvements. Day laborers receive \$2 to \$2.50, and those hired by the month from \$15 to \$30, with board.

The agriculture of Allen County is of a progressive and advanced type. Farm machinery of the latest designs—corn planters, shredders, harvesters, wheat drills and harvesters, manure spreaders, ditching machines, in fact everything needed to handle the soil and the crops in the most economical way—is found upon the farms. The soils being strong and fertile, but little resort is had to commercial fertilizers. On the other hand, the great value of barnyard manure is thoroughly appreciated, and large quantities are used, mainly on the corn and wheat.

SOILS.

Indiana lies within the region which during comparatively recent geological time was subjected to glaciation, the ice having invaded the country a number of times. This great snow-covered ice sheet, 1,000 feet or more in thickness, covered the country as far south as the Ohio River and in some places beyond that river, just as Greenland is covered to-day. During its slow advance southward great quantities of earth and rock which were carried on the ice, pushed along beneath it, crushed and mingled, were upon the melting of the ice sheet left as a thick mantle over the surface of the country, in many cases entirely obliterating the then existing surface features. Geologists believe that there were four or five successive invasions of the ice over this section, each adding to the vast deposits found to-day—an earthy mass of heterogeneous material covering the northern three-fourths of the State, in some places to a depth of 500 feet. In Allen County the depth of the deposits ranges from 40 to 280 feet.

As far as Allen County is concerned, the most important period of glaciation was the Wisconsin stage, a period marked by heavier deposits of drift than those of any other ice invasion.

Ridges of drift material, known as terminal moraines, form important topographic features of the county. These moraines are varied in constitution and in the arrangement of the different grades

of material, like clay, sand, and gravel, and give rise to several soil series. One of the most important of these ridges is the St. Marys Ridge, named from the St. Marys River. The course of the river in the eastern part of Allen County is determined for a distance of about 20 miles by this ridge, and in like manner the course of the St. Joseph River is controlled for nearly the same distance.

Another moraine of less importance is known as the Van Wert Ridge, which crosses the Maumee River about half way between Fort Wayne and New Haven. Other smaller moraines are found in different parts of the county.

Another topographic feature of the county, important both in area covered and its influence on the soil formation, is the extensive depression now known as the Maumee Valley, which during Glacial times was a great inland lake receiving the waters of the St. Marys and St. Joseph rivers. The outlet of this lake was to the westward through the Little River and Wabash Valley to the Gulf. Large amounts of reworked glacial débris were carried into this inland lake and spread out over its bottoms as sediments. Later, when the level of Lake Erie was lowered, the waters of this inland body broke through one of the lower moraines hemming it in on the north and thus established the present drainage toward Lake Erie.

Evidently the former river flowing westward from Maumee Lake was a very large one, as is indicated by the large river valley which it occupied. This valley extends from a point east of the city of Fort Wayne to the southwest, joining the present Wabash River Valley near Huntington. The old channel or valley is known as the Erie-Wabash gap and the materials found there give rise to a number of soil types.

In connection with the description of Maumee Lake another interesting feature should be mentioned. This is the abandoned channel which crosses Adams Township, from the St. Marys River to a point 2 miles southwest of New Haven. This channel was probably used during interglacial times by the St. Marys River, which evidently made a cut-off and emptied into the interglacial Maumee Lake at a point just south of where New Haven now stands. The banks are well defined, rising in height from 15 to 25 feet above the intervening lowlands, and the old stream bed is occupied by the Clyde clay, which is the predominating soil of the glacial lake bed itself.

Further evidence of the interglacial position of the St. Marys River is seen in the delta formed at its supposed mouth. This delta, known as the New Haven delta, has a length east and west of 4 miles and a width north and south of about 1 mile. It is composed largely of sandy types of soil, several small sand knolls occurring in its eastern extremity.

No rock outcrops occur within the county, but from deep well borings the underlying formations have been determined. As these in no way influence the soils they may be dismissed with the merest comment. In the boring of the artesian well in the court-house square at Fort Wayne the drift was found to extend to a depth of 88 feet, where it rested on limestone. The limestone in the southern half of the county is the Niagara of the Upper Silurian and in the northern half Corniferous of the Devonian. South of Maysville, near the northern border of Maumee Lake basin, flowing water is found 35 to 45 feet below the surface. These wells are fed by reservoirs in the gravel beds of the moraine to the north.

All the soils of Allen County are of glacial origin. The upland soils are derived directly from the glacial deposits, while the glacial lake and swamp types are derived from the drift merely reworked by streams and laid down in more or less quiet waters. Such material and processes of formation give the Clyde series of soils. The alluvial lands are similarly derived. They belong to the Wabash series.

In all fourteen soil types, representing five soil series, were mapped. Two types are members of the Miami and three of the Dunkirk series, the Clyde has three representatives, the Wabash series two, and the Waverly series one. Muck, Peat, and Meadow, of the organic and miscellaneous soil groups, were also mapped.

The name and the actual and relative extent of each soil are shown in the following table:

Areas of different soils.

Soil.	Acres.	Percent.	Soil.	Acres.	Percent.
Miami clay loam.....	244,480	57.3	Dunkirk fine sandy loam....	4,096	1.0
Clyde clay.....	65,920	15.4	Dunkirk fine sand.....	2,944	.7
Miami black clay loam.....	51,840	12.1	Waverly silt loam.....	2,240	.5
Clyde loam.....	12,800	3.0	Wabash fine sand.....	1,536	.4
Muck.....	11,392	2.7	Clyde fine sandy loam.....	1,408	.3
Wabash silt loam.....	11,136	2.6	Peat.....	640	.1
Dunkirk sandy loam.....	10,240	2.4	Total.....	426,880	.....
Meadow.....	6,208	1.5			

MIAMI CLAY LOAM.

The soil of the Miami clay loam consists of a light-brown or gray silty loam from 8 to 12 inches deep, beneath which to a depth of about 24 inches is a heavy yellowish-brown silty clay. The silt content of the subsoil decreases with depth and at an average of 2 feet gives way to a stiff, impervious brown clay. Frequently in the rolling areas of the type a layer of silt 1 to 3 inches in thickness is found immediately beneath the surface soil.

Glacial boulders and rock fragments, consisting of granite, quartz, syenite, greenstone, and siliceous slate are sometimes present on the surface and disseminated through both soil and subsoil, but these are seldom numerous enough to interfere with cultivation. A few small gravel pits occur in steep banks adjacent to stream courses at a depth of 15 to 25 feet below the surface.

Where the Miami clay loam occurs bordering large depressions and also as knolls and ridges within such depressions, there is nearly always present in the soil varying amounts of fine sand in excess of the typical soil. This is particularly true in Lake Township.

Land of this type of soil is found in every township and covers a greater proportion of the county than all the other types of soil. The largest and most typical areas occur in the northern and western parts of the county. Slight local variations due to the varying drainage conditions occur throughout the type, but generally it possesses marked uniformity in texture. The surface features range from gently rolling to hilly, and in the northern part of the county it occupies some of the most broken and roughest areas. When the Miami clay loam is found in fairly level hummocky country the small knolls possess the texture and color of the Miami clay loam, while the intervening spaces are the Miami black clay loam. It should be borne in mind, therefore, that the boundary lines as indicated on the map between these two soils do not always denote an abrupt change from the one soil to the other, and some few areas were found in which the Miami clay loam and Miami black clay loam were so mingled that they could not be shown as separate and distinct soils upon a scale of 1 inch to 1 mile. In such cases the map shows the predominating soil. These hummocky areas support an uneven crop growth, owing principally to the difference in the productiveness of the Miami clay loam on the hummocks and the Miami black clay loam in the depressions.

The Miami clay loam is the best drained of any of the heavy soils, but it is somewhat more deficient in organic matter than the Miami black clay loam, because it has never passed through the swampy conditions of the latter type. Upon the rougher areas, where the drainage is sometimes excessive, considerable washing and gullying has taken place on the slopes. The soil in these eroded areas is more deficient in organic matter than elsewhere and has an ashy appearance. Usually artificial drainage is not necessary, but there are some rather low, flat interstream areas and draws which have been greatly improved by tiling. The type is of glacial origin and is derived from the weathering of the mantle of glacial till. The original tree growth consisted of oak, ash, hickory, elm, sugar maple, and a few sycamore and beech, and many fair-sized wooded areas still remain.

The Miami clay loam is the general-purpose soil of the county, and upon it all the varieties of farm crops are produced. If handled at the proper time it is not a difficult soil to cultivate. If plowed when either too wet or too dry it has a tendency to clod. By disking before plowing it is claimed a more desirable seed bed may be secured. Wheat, oats, corn, and hay are the principal crops. The yield per acre of wheat ranges from 18 to 30 bushels; of oats, 30 to 50 bushels; of corn, from 25 to 50 bushels; and of hay from $1\frac{1}{2}$ to $2\frac{1}{2}$ tons. For wheat the Miami clay loam is considered one of the best soils in the county, but for corn it is excelled by other soils and the yields are below those secured from the darker colored types.

A common rotation on this type is to turn under the sod and keep the field in corn for two years; the following year a liberal application of barnyard manure is given and the field sown to oats; wheat follows in the fall, and at the same time the land is seeded to timothy and in the spring to clover. In growing wheat some farmers advise plowing clover or corn-stubble land in June, and if there has been abundant rainfall a later plowing or disking before sowing. Green manuring is a very valuable means of restoring organic matter to the soil and should be practiced more generally. The Miami clay loam sells for \$50 to \$100 an acre.

The following table gives the average results of the mechanical analyses of fine-earth samples of this soil:

Mechanical analyses of Miami clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19975, 19977	Soil	0.5	3.0	2.9	6.1	5.6	54.9	26.8
19976, 19978	Subsoil .....	.0	1.5	1.6	4.9	5.9	50.1	35.7

MIAMI BLACK CLAY LOAM.

The surface soil of the Miami black clay loam is a heavy dark-brown or black loam or clay loam with an average depth of 12 inches. Near the margin of the areas the depth of the soil is usually considerably less than this. The prevailing dark color is due to accumulations of organic matter, and in the lower depths of the soil, where the organic content naturally decreases, the color gradually becomes lighter. The soil gradually becomes heavier with depth and at about 14 inches below the surface grades into the subsoil, a light-brown or mottled yellow and brown clay or heavy clay loam, which at a depth of about 24 inches changes into a yellow or light-brown, heavy, impervious clay continuing to a depth of 3 feet and

more. When wet the soil is sticky and gummy and if worked in this condition it bakes and clods badly, but when dry it is usually friable and loamy and can be handled with comparative ease.

Large areas of this type of soil occur in the southern tier of townships and in the region north and west of Arcola. Other small isolated areas, many too small to be shown upon the map, occur in all parts of the county outside of the Maumee Lake Basin and the Erie-Wabash channel.

The Miami black clay loam occupies shallow, saucerlike basins and depressions in the uplands and narrow strips along some of the smaller streams. The upland areas are often large and irregular and are sometimes connected with each other by a narrow strip of the same soil. Owing both to the level, depressed surface of the type and the impervious nature of the subsoil the drainage is naturally poor. The greater part is drained by open ditches and tile drains, and is under cultivation. The undrained and uncultivated areas support a heavy growth of oak, hickory, and elm.

This type of soil owes its origin to an accumulation of fine material washed from the uplands into the depressions. The impervious character of the subsoil prevented underdrainage from these depressions and the decay of vegetation which grew luxuriantly under the existing swampy conditions resulted in the accumulation of large quantities of organic matter. Near the margins of some of the areas of Miami black clay loam small elevations locally known as "clay knobs" occur. The soil here was not subjected to the same swampy or poorly drained conditions and therefore carries less organic matter and is lighter colored. When large enough to be mapped they were classed as Miami clay loam. The type as it occurs along the small streams and in draws usually contains a larger amount of sand and silt, the result of recent wash, and is therefore more friable and loamy, and easier to work.

When thoroughly drained this type becomes very productive, capable of producing large yields of corn, oats, and hay. The best results seem to have been secured in the production of corn, which yields from 40 to 75 bushels an acre. Oats often produce too heavy a growth of straw, but under favorable conditions may yield from 30 to 40 bushels per acre. Hay yields from $1\frac{1}{2}$ to 2 tons per acre. Clover frequently fails to survive the second winter on account of the heaving to which this type of soil is prone. The type is usually permitted to remain only a short time in sod. The price of the Miami black clay loam varies from \$50 to \$100 an acre, depending mainly upon the improvements in drainage, the most important factor in the cultivation of this type.

The following table gives the results of mechanical analyses of the soil and subsoil:

Mechanical analyses of Miami black clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19971	Soil	0.2	2.3	3.1	12.6	10.2	51.1	20.1
19972	Subsoil .....	.5	1.6	2.0	11.0	9.4	52.1	22.7

CLYDE FINE SANDY LOAM.

The Clyde fine sandy loam consists of 10 to 15 inches of a dark-gray or black material, varying in texture from a fine sandy loam to a fine sand, underlain to 36 inches or more by a dark-gray or black fine sandy loam or loam. The relatively high percentage of organic matter present renders the type a loamy, mellow soil, very productive and easy to cultivate.

The type is of limited extent, the largest areas being found near New Haven and in the prairie southwest of Fort Wayne, with a few other scattered patches in the northern part of the county. It is closely associated with the Dunkirk fine sand, being practically the same in origin. These two types were deposited at the same time, but the material forming the Clyde fine sandy loam fell in deeper water, and these lower places afterwards remained longer in a swampy condition than the shallower portions of the former lake bottom. These long-continued swampy conditions were favorable for the accumulation of organic matter, and hence the reason for higher organic content of Clyde fine sandy loam. The surface is slightly undulating and for the most part the natural drainage is good.

The Clyde fine sandy loam is admirably adapted to the production of small fruits and vegetables, and areas near markets are mostly devoted to these crops. It is also a good corn and grass soil.

The results of mechanical analyses of the soil and subsoil of this type are shown in the following table:

Mechanical analyses of Clyde fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19957	Soil	0.3	1.7	4.7	50.1	14.4	21.6	7.4
19958	Subsoil .....	.6	1.5	3.8	33.9	17.5	27.6	14.7

CLYDE LOAM.

The Clyde loam consists of a dark-brown or black loam or clay loam, from 8 to 12 inches deep, underlain to 36 inches or more by a gray, drab, or yellowish clay or clay loam. There is usually no coarse material in either the soil or subsoil, but in section 18, Jackson Township, there is a small area which consists of a heavy, medium, black sandy loam with numerous small shells strewn upon the surface, and underlain by a sticky, gray coarse sand. It represents a reclaimed swamp area and is a little darker colored than the remainder of the type.

The Clyde loam is most extensively developed in the northern part of the Lake Maumee Basin. It forms an almost continuous strip of varying width, immediately south of the north shore line of this glacial lake bed. Other smaller areas occur as depressions in the prairie and elsewhere in the county. The natural drainage is poor, but most of it has been improved greatly by the construction of large open ditches and tile drains.

The formation of the Clyde loam has taken place under practically the same swampy conditions as the Clyde clay. The wash from the sandy beach line and the finer material brought down by the streams from the uplands have become mingled with the soil, giving it a loamy texture. It is therefore more easy to cultivate than the Clyde clay, does not clod or heave as much, and is better adapted to small grains. Most of the type is drained and under cultivation, all the varied farm crops of the county being grown to greater or less extent. Corn, the leading crop, gives yields of 40 to 75 bushels, wheat 15 to 30 bushels, oats 30 to 60 bushels, and hay 1 to 2 tons per acre. Cabbage, onions, sugar beets, and potatoes are grown successfully, but only in a limited way. The poorest drained areas are still uncleared and support a heavy growth of elm, ash, oak, and hickory.

The results of mechanical analyses of the soil and subsoil of this type are shown in the following table:

Mechanical analyses of Clyde loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19953	Soil	0.4	3.8	5.6	20.8	15.5	34.1	19.6
19954	Subsoil	1.3	5.6	6.3	18.9	14.3	33.5	20.1

CLYDE CLAY.

The Clyde clay consists of 6 to 10 inches of drab, black, or dark-brown clay, underlain to a depth of 3 feet or more by a drab or

yellow, often mottled, plastic and impervious clay. There is only a very small percentage of fine sand present in the soil and its tough, waxy character makes it a difficult type to work. When wet the soil is plastic and tenacious, but when dry the surface breaks into small cubical blocks about one-fourth inch in diameter, and deep cracks, 2 to 4 inches wide, sometimes extend several feet below the surface. The soil contains a large amount of organic matter and where well drained after cultivation for a time becomes more pulverulent, appearing more like a clay loam. Near Muck areas there is usually a few inches of mucky material overlying a heavy drab clay; this phase supports a luxuriant growth of Bermuda grass.

The Clyde clay stands second among the soils of Allen County. It is found principally in the eastern part of the county, where it occupies the large glacial lake depression known as the Maumee Lake Bottom. It is therefore lacustrine in origin, consisting of reworked glacial till laid down in quiet lake waters and after the recession of the lake subjected to wet, swampy conditions for a long period. The lake bed embraces about 100 square miles of territory in Allen County and extends east into Ohio. It is V-shaped, with the apex at New Haven. Good-sized areas also occur in the level prairies southwest of Fort Wayne, to the southeast of Hoagland, and in Adams Township. Smaller bodies occur in the northern part of the county. The surface features are flat or slightly undulating, broken here and there by a low sand or gravel ridge or by a stream depression.

Owing to the general level topography and the heavy texture of the soil, together with its low-lying position, artificial drainage is necessary to cultivation. Large open ditches usually parallel the roads and carry off the water conveyed to them by numerous tiled laterals. The natural drainage in the northern part of the Maumee Lake Bottom is slightly better than in other parts, and having been cultivated longer the soil in this section is in a better state of tilth than the rest of the type.

More care is required in handling the Clyde clay than any of the other soils of the county. If plowed when too wet or too dry it breaks up into large irregular clods which can be pulverized with difficulty. During a very wet season crops suffer from excessive moisture, but with an average amount of rainfall or less large yields of corn, oats, and hay are secured.

Corn is the principal crop grown and the type is the recognized corn soil of the county. The average yields in favorable seasons range from 60 to 75 bushels per acre, while 100 bushels is not an uncommon yield. On well-drained fields oats yield from 30 to 50 bushels. Wheat is seldom grown, on account of injury from the heaving of the soil in winter. The type is well adapted to grass, and from $1\frac{1}{2}$ to $2\frac{1}{2}$ tons of hay per acre are sometimes secured. Sugar

beets are being successfully grown in the eastern part of the county, the yields ranging from 8 to 12 tons per acre. It is well adapted to this crop, but on account of the scarcity of suitable labor sugar beets are not grown extensively at present.

The Clyde clay is the heaviest and strongest soil of the area, and taken as a whole commands the highest price. Condition of drainage has especial influence on the value. Land having well-established systems of drains range in price from \$100 to \$150 and more an acre.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Clyde clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19961	Soil	0.3	4.9	3.2	12.5	4.4	46.4	27.9
19962	Subsoil .....	.7	1.7	2.7	7.1	5.2	46.5	35.5

DUNKIRK FINE SANDY LOAM.

The Dunkirk fine sandy loam consists of 8 to 15 inches of light-brown fine sandy loam, underlain to a depth of 36 inches by a brown or yellow silty loam or fine sandy loam. It is closely associated with the Dunkirk fine sand, and near the contact of these types the soil is a loamy sand, deeper and much lighter in texture than the typical soil.

Of limited extent, this soil is found principally along the shore lines of the ancient lakes. It occurs as long, narrow ridges from 2 to 10 feet high, and also in a small way as gently rolling areas. In the northern part of the county, along the northern edge of the Lake Maumee bottom, numerous other areas occur which have the form of eskers. It is derived mainly from reworked glacial material piled up in the old lake beaches. Since that time it has been somewhat modified by wind action and shifted about so as to form low sand dunes. Owing to its texture it is naturally well drained.

With an average amount of rainfall this porous, easily cultivated soil gives good yields of the general farm crops, but during very dry seasons the crop yields are cut short for lack of moisture. Corn averages from 40 to 50 bushels, oats from 25 to 30 bushels, and wheat 15 to 25 bushels per acre. It is a splendid clover soil. Alfalfa has been successfully grown, and the acreage of this legume could be profitably increased. Several fine orchards were noticed, and besides the tree fruits, small fruits are successfully grown. Potatoes and all vegetables adapted to the climate do well.

The following table gives the results of mechanical analyses of the soil and subsoil:

Mechanical analyses of Dunkirk fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19969	Soil	0.7	4.4	9.4	25.7	12.3	34.1	13.4
19970	Subsoil	1.2	3.6	5.9	14.9	14.3	43.0	16.7

DUNKIRK FINE SAND.

The soil of the Dunkirk fine sand consists of a light-brown loam or yellow fine sand, with a depth ranging from 6 to 10 inches. The subsoil is a yellow, loose, incoherent fine sand, which extends to a depth of 36 inches. In the few inches at the surface there is enough organic matter, together with fine material, to make the soil loamy in texture and somewhat more coherent than the subsoil. It is an easy soil to plow and cultivate.

The Dunkirk fine sand is limited in extent, the largest bodies being situated in the vicinity of New Haven, around Fort Wayne, and in the southern half of the "prairie" lying southwest of the city. It also occurs along the larger stream courses in the northern half of the county. The type is developed as ridges, rounded hills, and knolls from 2 feet to more than 30 feet in height, and possesses excellent natural drainage. These islandlike bodies vary in size from knolls containing a few acres to long, narrow ridges many acres in extent.

In origin this soil is traced directly to reworked glacial debris, carried into the old lakes and assorted by wave action and piled up along the shores as beach lines. Later these beaches have been considerably modified in extent and shape by wind action and the resulting sand dunes are often found some distance from the original position of the material.

Owing to its limited extent, the type is of little agricultural importance in Allen County. Its open, porous nature and thorough drainage, however, make it a typical early truck soil, and this is the class of farming usually followed. In the vicinity of Fort Wayne it is devoted almost exclusively to market gardening, and all kinds of vegetables, melons, and small fruits are successfully grown. Peaches and apples produce a fine-flavored fruit. Any crop requiring a light sandy soil will do well upon the Dunkirk fine sand. The native timber growth is oak and the greater part of the type supports a good growth of grass. The subsoil is valuable as a building sand and is used considerably for construction purposes.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Dunkirk fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19967	Soil.....	0.1	0.8	5.1	70.0	10.5	8.7	4.6
19968	Subsoil.....	.0	.7	5.6	73.4	9.0	8.8	2.4

DUNKIRK SANDY LOAM.

The Dunkirk sandy loam to a depth ranging from 10 to 15 inches consists of a medium to fine sandy loam varying in color from gray to brown or reddish brown. This surface material is underlain to a depth of 3 feet by a reddish-brown sandy loam or sandy clay which acts as a cement or matrix holding together a large quantity of coarse sand and fine gravel. Frequently fine gravel is found strewn upon the surface, but not in quantities great enough to interfere with cultivation.

Immediately underlying the subsoil beds of gravelly clay varying from 2 to 4 feet in thickness often occur, and below these are frequently found beds of a purer gravel, usually from 4 to 10 feet in thickness. Nearly all of the sand and gravel used in the county for road material and railway ballast have been taken from these gravel pits, and the exposures thus made afford an excellent opportunity for studying the arrangement of the deeper strata underlying this soil.

The texture of the Dunkirk sandy loam varies greatly in different parts of the county, but the subsoil possesses great uniformity. In Perry and Cedar Creek townships, for example, the soil contains a larger proportion of medium to coarse sand than in other parts of the county, while south of Fort Wayne the soil is composed of a compact fine sandy loam or light-textured loam. In the eastern half of the county the type is composed largely of a medium-textured sandy loam.

The Dunkirk sandy loam occurs as gently rolling country, terraces, isolated knolls, and detached ridges, and possesses excellent drainage. It is typically developed in the ridges which represent the old beach lines of Lake Maumee. The ridge running northeast from Fort Wayne, along which the Maysville wagon road extends, formed the north shore of this glacial lake, and the Van Wert wagon road follows a ridge which represents the south shore of the lake.

The general farm crops of the region are grown upon the type, but wheat is given preference, as the soil is recognized as one of the best in the county for that crop. Corn, oats, and hay are also grown. The yields of wheat range from 20 to 30 bushels, of corn from 50 to 75 bushels, oats from 30 to 40 bushels, and hay from 1½ to 2 tons per acre.

All kinds of market-garden crops and small fruits do exceptionally well. It is considered the best orchard soil of the area, peaches, apples, and cherries producing fine, well-flavored fruit. It is also an excellent potato soil.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Dunkirk sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19979, 19981	Soil.....	1.8	9.8	18.4	40.8	5.8	17.6	6.0
19980, 19982	Subsoil.....	5.1	12.7	12.4	30.5	4.1	21.5	13.2

WABASH FINE SAND.

The Wabash fine sand to a depth of about 15 inches consists of a brown fine sandy loam or loamy sand. The subsoil is lighter than the surface soil both in color and texture, and at a depth of 2 feet frequently grades into a gray or yellow fine sand. The soil is friable and easily cultivated.

Most of this soil, which is of only limited extent, is found along the St. Joseph River in Cedar Creek Township and along Cedar Creek in sections 19 and 20 of the same township. A few scattered areas also occur along the Maumee River between New Haven and Fort Wayne. It is of alluvial origin and confined to the flood plains of the larger streams. The most typical areas occur upon the inner bends of the streams and adjacent to the stream courses. The type is frequently overflowed, and each successive flood leaves a thin deposit of fine sand and organic matter upon the surface. The areas consist of low, sandy knolls, ridges, and old stream channels, and except in flood times they are fairly well drained.

Corn is the principal crop, and in favorable seasons the average yield ranges from 40 to 75 bushels per acre. On the higher, better drained areas some oats and wheat are grown and fairly good yields are produced. Truck crops also do very well on this type of soil.

The following table shows the results of mechanical analyses of the soil and subsoil of Wabash fine sand:

Mechanical analyses of Wabash fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19987	Soil.....	0.0	0.4	3.9	59.4	12.8	18.2	4.4
19988	Subsoil.....	.0	.2	4.9	61.7	12.7	14.5	5.0

WABASH SILT LOAM.

The Wabash silt loam is usually a brown silty loam, about 10 inches deep, underlain to a depth of 36 inches or more by a lighter-colored material of the same texture as the soil. The texture of the type as a whole, however, is quite variable, depending upon distance from the stream channel and the character of the soils upon the hills of the surrounding country. Near the present stream channel there is usually increased sand content, while in some of the depressions farther from the stream there is enough clay present to approximate the standards of a clay loam.

Little of this soil is found in Allen County. It occurs mainly along the bottoms of St. Joseph, St. Marys, and Maumee rivers. It is an alluvial type, and owes its origin to material washed into the streams from the hills and deposited along the bottoms at times of overflow. It is found principally in the oxbows of these larger streams, although narrow strips are found along both the main and the smaller streams where the channels are less crooked. The type is subject to overflow, and occupies the level or flat first and second terraces or bottoms. The underdrainage is good, so that crops do not usually suffer from excessive moisture, except at times of high water, and the fields are soon in condition after the floods subside.

The Wabash silt loam contains a large percentage of organic matter and is a strong, productive type. Corn is the principal crop, and during favorable seasons yields from 50 to 75 bushels per acre. Higher lying, better drained locations are often planted to wheat, and have yielded as high as 30 bushels per acre. Oats yield from 25 to 40 bushels and hay 2 tons per acre.

The results of mechanical analyses of soil and subsoil of this type are given in the following table:

Mechanical analyses of Wabash silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19983	Soil	0.0	0.9	0.8	4.8	8.4	64.8	20.0
19984	Subsoil .....	.0	.5	.7	5.7	9.7	62.1	20.9

WAVERLY SILT LOAM.

The Waverly silt loam consists of a light-gray or brown silt loam from 8 to 12 inches deep, resting on a subsoil of yellowish-brown silty clay, becoming somewhat heavier as the depth increases, but extending without material change below the limit of the borings, which are made to a depth of 36 inches.

The type is of very limited extent and is rather variable in texture. It occupies narrow strips or small areas along the Maumee River, from 10 to 12 feet above the present flood plain, and seldom extends back more than one-fourth mile from the stream. The most typical area occurs north of New Haven, along the north bank of the Maumee River. The other areas were mapped southwest of New Haven, in what is known as the New Haven delta. These areas contain more fine sand and coarse silt in the surface soil than is usual for the areas adjacent to the river, and the color of the soil is also darker, owing to the presence of slightly more organic matter.

In surface features the Waverly silt loam is nearly level, with a gentle slope back from the stream, where the silt gives way to heavier material. It is usually deficient in organic matter, and the soil when wet becomes quite sticky. The soil is best suited to grass, and is seldom planted to corn on account of small yields. Wheat and oats do fairly well.

The following table gives the results of mechanical analyses of typical samples of the soil and subsoil of this type:

Mechanical analyses of Waverly silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
19985	Soil	0.0	0.7	0.8	2.1	7.6	64.7	23.8
19986	Subsoil .....	.0	.7	.7	2.4	7.3	62.1	26.4

MUCK.

The Muck consists of a mass of dark-brown to black more or less decomposed vegetable mold, usually 3 feet or more in depth, though in places it may be only a few inches deep. The color of the material sometimes becomes reddish brown at some distance below the surface, and at this and lower depths coarse and fine vegetable fibers often become noticeable. Beneath this mass of organic material there is found a light-blue or drab clay, which in places is somewhat sandy. Along the margins of the larger areas and bordering the banks of the open ditches considerable fine sand and silt have become incorporated with the Muck. In the northeastern part of the county a number of the Muck areas have a reddish-brown fine fibrous substance with which there is mingled but a small amount of mineral matter. This phase represents the transition stage between Peat and true Muck. As these areas are closely associated with the more typical Muck areas and become darker with cultivation and more thoroughly oxidized when exposed to the air, they have been mapped as Muck. Other areas of Muck occur as isolated patches from one to many acres in extent in the intermorainic plain which extends diag-

onally across Lake, Eel River, and Perry townships. Long, narrow strips of Muck also occur along what were probably small stream channels during glacial times, and all of the present lakes of the area are surrounded by narrow fringes of the type.

Occupying depressions the Muck areas are level and flat and possess poor natural drainage. They receive the drainage from higher ground, and often, even in times of drought, the water table is very close to the surface. Artificial drainage is therefore necessary before cultivated crops can be successfully grown. A great deal of good has been accomplished by the construction of large open ditches, into which lateral tile drains and open ditches empty, but much yet remains to be done in this direction. Muck areas represent depressions of various kinds in which there has been a great accumulation of organic matter resulting from the decay of the plants which have grown in these wet places. The degree of the decomposition is the distinguishing feature between Muck and Peat, the former representing a more advanced state of decomposition than the latter. Along the margins of the larger areas and bordering the banks of the open ditches a considerable amount of silt and fine sand is mixed with the organic matter. This is either a result of overflow in the ditches or of wash from higher ground.

Many of the Muck areas support excellent pasturage, but the greater part of the type is covered with a dense growth of golden-rod, coarse grasses, and willows. Corn is grown on the better drained areas and when not injured by rains or early frosts yields from 60 to 100 bushels per acre. The quality of corn, however, is inferior to that grown upon the other soil types. Large yields of potatoes are secured on the Muck areas, but they are usually inferior in quality. The areas having considerable sand and wash material mixed with the mucky surface produce larger yields and a product of better quality. Cabbage, onions, celery, and peppermint are grown to a limited extent and considering the abundant yields it is surprising that these crops are not grown more extensively.

In handling Muck soils it has frequently been found that they can be considerably improved by the use of coarse barnyard manure, and also by the use of straw or other coarse litter, which should be thoroughly incorporated with the Muck. Throughout the central States it has been found that commercial fertilizers, containing a large percentage of potash salts, are especially beneficial upon Muck and Peat soils. A fertilizer establishment located near Fort Wayne uses Muck as a filler in the mixing and preparation of its fertilizers.

PEAT.

Peat consists of 3 feet or more of coarse brown vegetable fiber more or less permanently saturated with water. When thoroughly drained

and tilled the fibrous material readily breaks up into a fine powder closely resembling snuff both in texture and color. It contains practically no mineral matter and when dry burns readily, often to a depth of several feet.

Only a few typical areas of Peat occur in Allen County, but where possible these were separated from Muck. The largest body of the type occurs southwest of Fort Wayne in the "prairie." A portion of this area is under cultivation, potatoes being almost exclusively grown. In favorable seasons, when the rainfall is below the average, potatoes yield from 150 to 300 bushels per acre, though over 400 bushels have been grown on an acre. The quality, however, is generally poor. Less than a half dozen other small patches of Peat occur and these are all confined to the northern part of the county. They are not cultivated, but support a dense growth of weeds, bushes, and aquatic plants, and also a few elm trees.

MEADOW.

The Meadow of this area includes the usual type of wet, low-lying narrow strips of waste land along the smaller streams, and also a few low-lying areas in the uplands.

The soil of the Meadow strips is variable, but for the most part is a dark-colored clay or clay loam. Where the Meadow is swampy there is usually found a coating of Muck, a few inches in thickness. In depressions the soil is a heavy black clay upon which water stands the greater part of the year. These areas if reclaimed by proper drainage would in time become similar to the Miami black clay loam. Most of the Meadow areas are unfit for cultivation at present and are left in timber and grass.

SUMMARY.

Allen County is located in the northeastern part of the State of Indiana. The surface features vary from the nearly level prairie-like areas of the glacial lake beds to the gently rolling and hilly country of the terminal moraines.

The average elevation above sea level is about 800 feet. The county has an area of about 667 square miles or 426,880 acres.

Allen County was organized in 1823, but not until the decade of 1840-1850 was there a marked influx of settlers.

The yearly rainfall ranges from 31 to 52 inches, with a mean of 38.7 inches. The absolute maximum temperature is 104° F., absolute minimum -25° F., and annual mean 49° F.

The drainage is principally into Lake Erie through the Maumee River and its tributaries. The western part of the county drains into the Wabash through Eel River, Aboite and Little Prairie creeks, and their tributaries.

The agriculture of Allen County is in a prosperous condition. Corn, wheat, oats, clover, and timothy are the principal products. Dairying and live-stock raising are practiced only in a limited way.

The importance of crop rotation is recognized, though no system is strictly adhered to. Stable manure is widely used. Farm labor is paid \$15 to \$30 per month, with board.

The average size of farms is about 90 acres and over one-half of them are operated by the owners. Most of the land in the county is improved. Value of farm land ranges from \$50 to \$100 an acre for the clay uplands to \$100 or \$150 an acre for the best drained and improved bottom land.

A number of steam and electric railways give ample transportation facilities for all parts of the county.

Fourteen soil types were recognized in this survey. These are all composed of glacial material and range from sand to clay. The light-colored soils represent the well-drained drift materials, while the dark soils are those which have remained in a swampy or poorly drained condition for a considerable period. The Miami series with two members and the Dunkirk series with three represent the light-colored soils. The Clyde series embraces the dark-colored glacial lacustrine soils with three members. Of the alluvial soils two belong to the Wabash and one to the Waverly series. Muck, Peat, and Meadow are the three remaining types.

The Miami clay loam is the predominating type. It is the general-purpose soil of the county, and constitutes more than one-half of the area of the county.

The Miami black clay loam when properly drained produces large yields of corn and grass.

The Clyde soils are best suited to corn. They require artificial drainage, and deep plowing in the case of the clay would increase the crop yields. Clyde clay is a very desirable soil for sugar beets, and their acreage could be profitably extended.

The Dunkirk soils are best suited to crops requiring a light, sandy soil. The fine sand is an ideal soil for early truck. Most of the market-garden produce consumed in Fort Wayne is grown upon this type. The sandy loam is the best wheat soil, and apples do exceptionally well upon it. The gravel subsoil of this type is used for road-surfacing material.

Of the alluvial soils, the Wabash fine sand and silt loam are subject to frequent overflow, but in favorable seasons produce large yields of corn and grass. The Waverly silt loam is deficient in organic matter and is best suited to grass.

Peat and Muck when thoroughly drained produce abundantly of corn and potatoes, but the yield of corn is usually light and chaffy

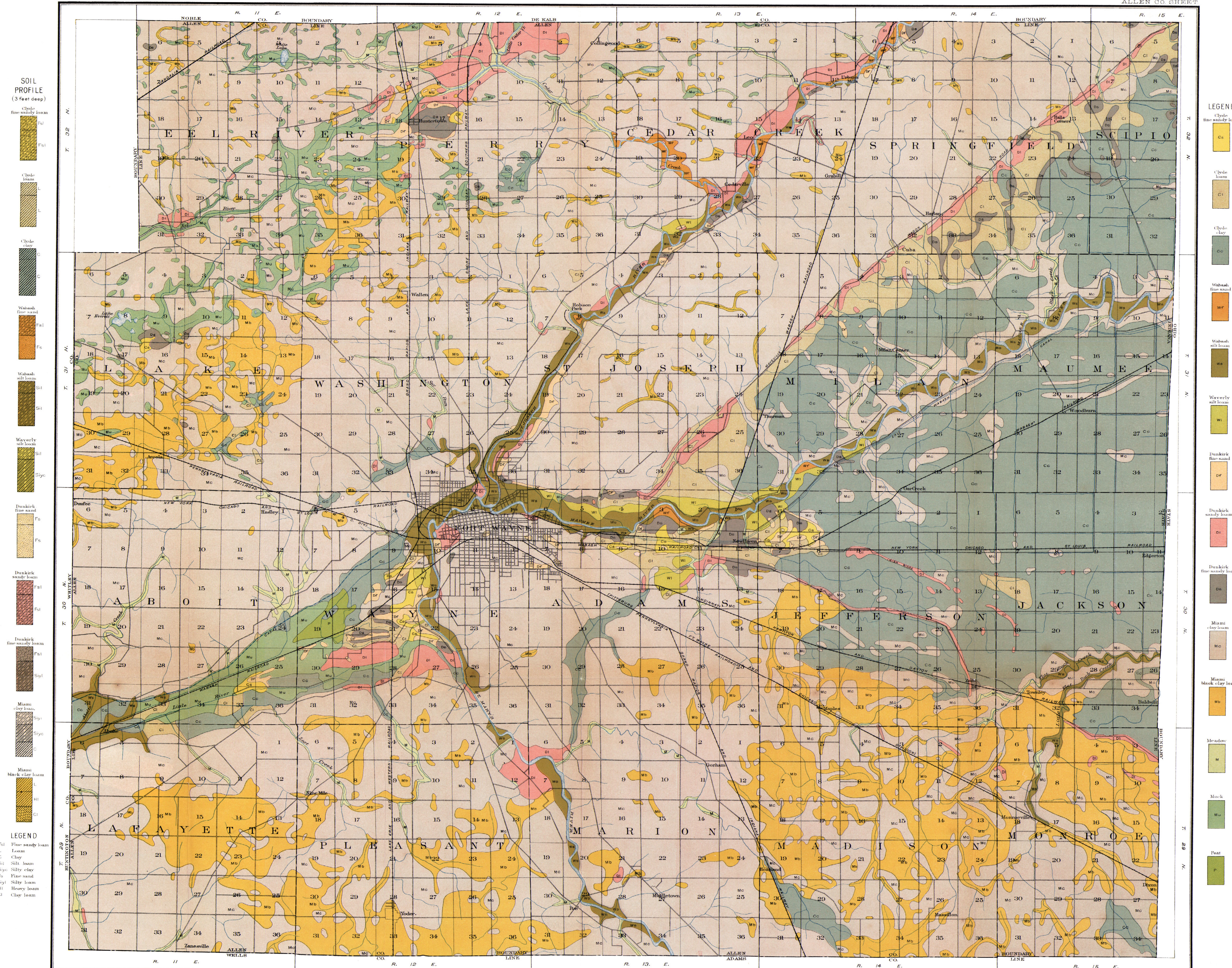
in quality. Special crops, such as celery, onions, and peppermint, should prove remunerative. Meadow land is best suited to pasturage.

The light-colored soils are in need of humus. Manure and catch crops turned under for green manure should be more extensively used. Much clover is grown for hay and seed, but more of it should be fed on the farm and returned to the soil as manure. Alfalfa has been successfully grown upon the Miami clay loam and the Dunkirk sandy loam. It is an ideal forage crop for all stock and a splendid soil renovator. It should be more extensively grown.

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SOIL PROFILE
(3 feet deep)

Clay
fine sandy loam
Fsl

Clay
loam
Cl

Clay
clay
Cc

Wabash
fine sand
Fsl

Wabash
silt loam
Si

Wabash
silt loam
Si

Waverly
silt loam
Si

Dunkirk
fine sand
Fs

Dunkirk
sandy loam
Fsl

Dunkirk
fine sandy loam
Fsl

Miami
clay loam
Siyl

Miami
black clay loam
Hi

LEGEND

Fsl Fine sandy loam
Cl Loam
Cc Clay
Siyl Silty clay
Fs Fine sand
Siyl Silty loam
Hi Heavy loam
Cl Clay loam

LEGEND

Clay
fine sandy loam
Cc

Clay
loam
Cl

Clay
clay
Cc

Wabash
fine sand
Fsl

Wabash
silt loam
Si

Wabash
silt loam
Si

Waverly
silt loam
Si

Dunkirk
fine sand
Fs

Dunkirk
sandy loam
Fsl

Dunkirk
fine sandy loam
Fsl

Miami
clay loam
Siyl

Miami
black clay loam
Hi

Meadow
M

Muck
Mu

Peat
P